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CROP SPECIFIC ASSESSMENT ON REPORTED CROP RAIDS IN COIMBATORE FOREST DIVISION

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ABSTRACT

Asian Elephants are globally endangered species because of various reasons like fragmented habitat, poaching, decline in habitat quality and raising level of Human Elephant Conflict (HEC) incidents. In India there were various reasons sighted for conflict in which most important is crop raiding. Understanding the sensitivity associated with particular crop and seasonal pattern in the reported incidents can help to design locally effective management strategy to reduce and mitigated HEC occurrence in future. This study analysed 10 year database on HEC incidents to understand the crop sensitivity and seasonal pattern of the reported incidents. Damage frequency varied significantly across the crops and it was found cereals, banana and sugarcane in commercial crops, pumpkin among vegetables are most sensitive crops to crop raid. Throughout the year crop was aided and it reached the peak during October to February of every year. Number of incidents were reduced after mitigation strategies were implemented. This study suggest better data management to efficiently monitor and evaluate HEC strategies in relation to crop choice.

KEYWORDS: Asian Elephants, Crop Raids, Human Elephant Conflict, Management Strategies, Crop Selection

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INTRODUCTION

Asian Elephants (*Elephas maximus*) are endangered because of shrinking population and fragmented habitat (Sukumar, 2003). Anthropogenic pressure on the limited resources and over exploitation resulted in exploitation of natural resources and habitat fragmentation. Since then elephants are exposed to the human settlement in search of food and water and this overlap resulted in negative interaction. Such negative interactions were termed as Human Elephant Conflict (HEC) and it was defined as “any human-elephant interaction which results in negative effects on human social, economic or cultural life, on elephant conservation or on the environment”. Such HECs are more common phenomenon with the farming communities adjoining to the protected area with wild elephant population. Rivalry dependence on the resources between farming community in fringes of protected area and wild elephants creates unique set of risk in production practices.

The interaction interface between elephant and people resulted in damage to crops, property, livestock and a relatively small kinds of injuries and fatalities in certain cases. Crop damage by wildlife and especially by elephants is not a new phenomenon, but rather had been in existence from the advent of agriculture. The extent of crop depredation by elephants varied across its ranges both in Africa and Asia (Sukumar, 2003). Crop-raiding incidents have been documented at high intensities in fragmented landscapes with low-density elephant population

as in northern West Bengal and at low levels in an area with prime elephant habitat and a high density population as in the Nilgiri Biosphere Reserve, South India (Sukumar, 2003). Thus extent of damage is suggested to be higher when there is closer proximity of cultivated lands to elephant habitats.

As human population expands into rural area and encroach forest area, viable habitat for elephant survival become more scarce, and increasingly depend on the agricultural lands to offset habitat loss. In order to prevent/mitigate the impacts of HEC, farmers in the fringe area as well as the governing agencies of State and Central government had adopted various mitigating technologies. But habituation of elephants to deterrents would pose a threat to the success of any long term unvarying efforts to exclude elephants from agriculture (O'Connell-Rodwell, Rodwell, Rice, and Hart, 2000)). Hence to devise efficient management strategy to mitigate the impact of HEC, it is necessary to understand the aspect of temporal distribution of the HEC incidents and crops that are mostly raided by elephants.

STUDY AREA

Coimbatore Forest Division falls under the Elephant Reserve No. 8, in which Nilambur-Silent Valley of Kerala forms the major portion of the tract. The study area lies between 11° 27' N and 10° 51 N latitude and 77°3' E and 76°39' E longitude. This forest division has a total area of 693.47 km2 in which 590.96 km^2 as core area and 102.50km^2 as buffer area, divided into six ranges namely Sirumugai, Mettupalayam, Periyanaickenpalayam, Coimbatore and Boluvampatty. This forest division has a wide ranging altitude from 279m (Bhavanisagar water spread area) to 1801m (Velliangiri Peak). The Coimbatore forest division is drained by two major perennial rivers such as Bhavani and Noyyal. The tributaries of the Bhavani river such as Coonoor river, Kallarpallam, Halurhalla, Thattapallam, Kodungarai pallam, Thekkampatty pallam and Manthorai pallam that are all perennial river flow through the forest division and are available to elephants during the dry season. Figure 1 shows study area map.

The study area receives rainfall both from southwest (May to August) and the North East (September to November) Monsoon (NEM). The major portion of the division gets more rain during NEM. Correspondingly, the major vegetation types vary from tropical thorn forests in the north to mixed dry deciduous forests in the south. Besides, moist deciduous, semi evergreen and small patches of shola grasslands are also found corresponding to terrain, altitude and rainfall on the west. Agricultural lands are surrounded in the east across the forest division. Among the vegetation physiognomy, species such as *Albizzia amara, Acacia leucopholea, Dicrostachyes cenerea* and *Tectona grandis* comprise the major proportion of trees in the study area. The elephant population in the study area is estimated to be about 65-70 animals. In dry season congregation of elephants can be seen more around the perennial water sources.

METHODOLOGY

The data analysed here derived from the state forest department records on compensation claims under the scheme "Asian Elephant Depredation and its Mitigation Measures". This scheme is concerned with managing the impacts of HEC by adopting a multipronged strategy involving habitat improvement including improving water sources, growing crops which are preferred by wild animals as fodder inside the forest areas itself, formation of physical barriers around the forest boundary, capacity building of the villagers, awareness creation and timely payment of compensation to the victims for loss of human life, livestock, damage to agricultural crops and property. Secondary data was assessed for its temporal pattern and then transformed to crop specific incidents to identify the most sensitive and resilient crops. Probability value was used to assess the sensitivity of the crops.

Probability assessment was used to estimate the risk of crop raid associated with particular crop in the region. In order to estimate the probability secondary data on HEC collected from range offices of Coimbatore forest division was transformed to crop specific incidents. Probability value was estimated using following formula

$$P = \frac{\text{Number of reported HEC incidents on crop of interest}}{\text{Total number of crop raid incidents reported}}$$

Figure 1: Study Area Map, Note: ● Study Ranges

RESULTS

Crop-raiding is suggested to occur due to attraction of elephants towards high nutrient quality and palatability of crops along with reduced chemical defenses and high water retention ability of cultivated crops compared to wild vegetation (Chiyo, Cochrane, Naughton, and Basuta, 2005; Sukumar, 1989, 1990). Hence studies HEC should begin with

an understanding of the site-specific incidents and their level of intensity. Information on when, where, and what elephants raid is significant to enable our understanding of their behavioural and feeding dynamics (Kulkarni, Mehta, Bhoominathan, and Chaudhuri, 2007; Sukumar, 2003); allowing us to understand the "why" of crop-raiding. This study examine the elephant's preference towards food from data available with forest department.

Crop specific assessment of HEC incidents will help us to identify sensitive crops subjected to crop raiding incidents. Figure 2 shows the crop specific incidences in the study area. HEC incidents were plotted based on elephant migration / kharif crop harvesting season, and chart shows that the incidents started with the onset of North East Monsoon (September) reached high during the commencement of dry season (January) and it declined after January. Once the South West Monsoon started events considerably reduced till next North East Monsoon.

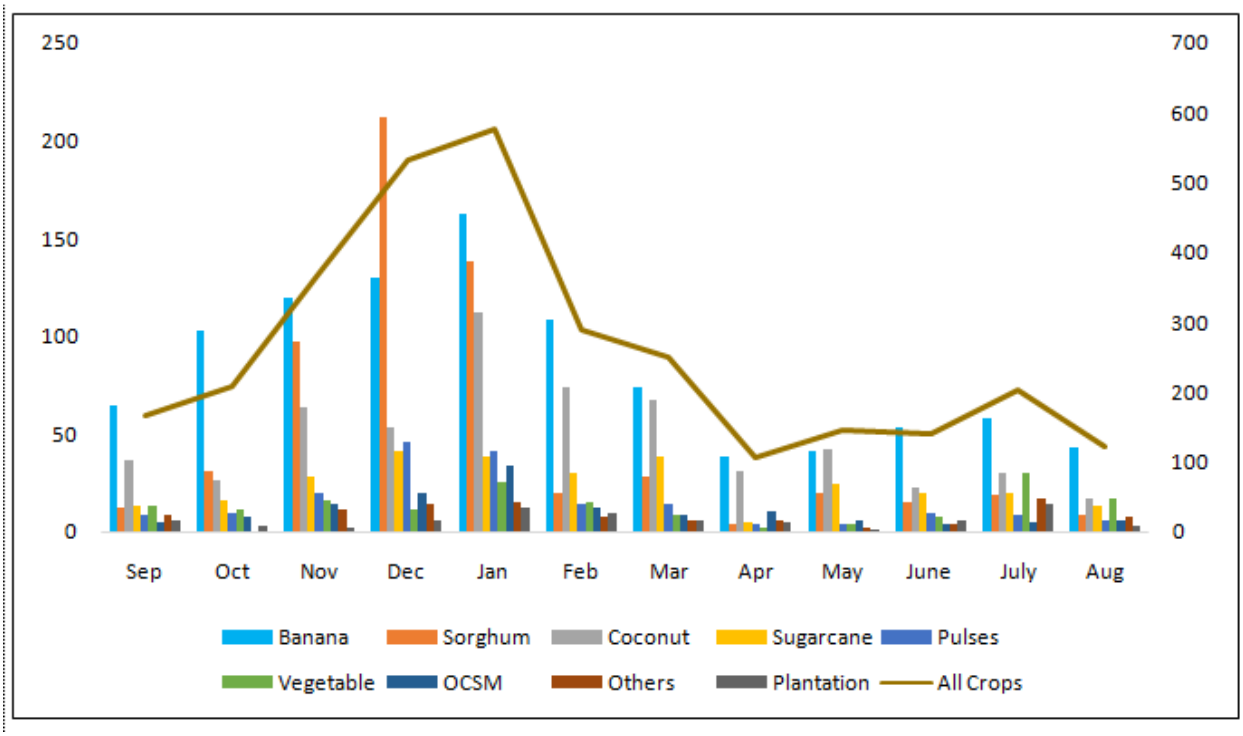

Figure 2: Crop Wise Raids Reported in Coimbatore Forest Division during 2001-2014
Note: All Crops in Secondary Axis

Pattern of crop raids reported irrespective of crop type was similar with the crops like coconut, sorghum, banana and other cereals and millets. Assessing number of crop raids reported in specific crop with respect to the total number of crop raids reported in the reference period (2001-2014) helped to understand crop's sensitivity to elephant raid. Based on this logic probability value was generated to every single crop reported to be affected by crop raids. This probability assessment on the reported incidents shed light on the risk associated in selecting particular crop as component in the farm plan. Crop specific HEC incidents that were reported in the last decade was consolidated and presented in Table 1.

Highest number of raids was reported on banana, followed by sorghum, coconut, sugarcane, and then crops pulses, vegetables, other cereals and small Millets (OCSM). Interestingly, people in the study were still growing banana, sorghum and coconut in large area. This is because banana has stable and fair price, exclude some operational cost like land preparation, comparing to seasonal crops that requires less intercultural operations, most of the farmers adopted chemical methods for weeding mainly to reduce cost and avoid labour shortage problem.

Table 1: Crop Wise HEC (Crop Raids) Reported in Coimbatore Forest Division during 2001-2014 (Number)

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Banana	162	108	74	38	41	53	58	43	64	103	119	130
Sorghum	138	20	28	4	20	15	19	8	12	31	97	212
Coconut	112	74	67	31	42	22	30	17	36	26	63	53
Sugarcane	38	30	38	5	24	20	20	13	13	16	28	41
Pulses	41	14	14	4	4	9	8	6	8	9	20	46
Vegetable	25	15	8	2	4	7	30	17	13	11	16	11
OCSM	34	12	8	10	6	4	5	6	5	7	14	20
Others	15	7	6	6	2	4	17	7	8		11	14
Plantation	12	9	6	5	1	6	14	3	6	3	2	6
All crops	**577**	**289**	**249**	**105**	**144**	**140**	**201**	**120**	**165**	**206**	**370**	**533**

Source: Calculated from secondary data

Coconut was mostly preferred by a section of farmers who were not at the farm and working or doing business in the nearby urban areas. Sorghum was mostly preferred by farmers having livestock, farmers in rain fed area were raising this for grain purpose. Data on HEC were transformed to crop specific incidents and probability values were estimated for every crop. Since, the maximum number of incidents that could happen in a year can't be fixed, these values were interpreted as subjective probabilities. Probabilities were assessed individually as well as by group and results are presented in Table 2. Probability value indicates sensitivity of crop and it was used to rank crop from most sensitive to least sensitive. Every farmer had a subjective quantification of risk associated with the crop while planning, which need not to be the same for all crops.

Assessing farmer's behaviour with probability shows his trade-off between income and risk i.e. for instance banana is most sensitive crop to raid but still farmers in large numbers preferred banana for cultivation. Such a behaviour shows that probability of banana being attacked and the resulting cost was not higher than the profit, farmer would gain from the production. This had brought out the fact that if a farmer choose banana in his annual plan then he would be indifferent between profit generated by banana and the risk associated with it.

Probability assessment of compensation claims for crop raid reveals that almost every crop raised by farmer was preferred by elephants as food. Since it is an herbivore it has no direct impact on livestock in the region but it has indirect impact on it by preferring the same food source to meet its requirement. It is indicated sorghum was the second highest crop subjected to raids by elephant. Sorghum was the cattle feed for marginal and small farmers practicing irrigated agriculture and main crop for every farmer practicing rain fed agriculture. In spite of the fact that sorghum was preferred by elephants still farmers continued to grow sorghum because it is very hard for them to find an alternative to meet their fodder and grain requirements.

Coconut which is less than five year of age is the third largest crop damaged by elephants. Farms with coconut trees aged more than six years are more resilient to HEC impacts. Since 1980 farmers had been shifting to coconut in the region to avoid factors like, labour shortage, price risk etc. The coconut is still preferred with drip irrigation system because most of the medium and large farms did not have potential successor to take up agriculture as a full time profession.

Table 2: Crop Specific Probability (Risk) to Crop Raids in the Study Area

Crop wise Probability		Paddy	0.0428
Crop Name	**Probability**	**Small Millets**	**0.0107**
Banana	0.2865	**Pulses**	
Cereals*	0.2685	**Crop Name**	**Probability**
Coconut	0.1630	Lab Lab	0.3217
Sugarcane	0.1092	Red gram	0.2937
Pulses*	0.0587	Cow Pea	0.1608
Vegetables*	0.0567	Black gram	0.1259
Turmeric	0.0177	Horse gram	0.0769
Arecanut	0.0144	Green gram	0.0140
Mango	0.0086	Pani Kadalai	0.0070
Flowers	0.0049	**Vegetables**	
Kamugu	0.0033	**Crop Name**	**Probability**
Tapioca	0.0029	Tomato	0.4420
Groundnut	0.0021	Ash Gourd	0.1739
Papaya	0.0012	Onion	0.1159
Curry leaf	0.0008	Pumpkin	0.0652
Fodder grass	0.0008	Brinjal	0.0507
Bamboo	0.0004	Bitter Gourd	0.0435
Cotton	0.0004	Chillies	0.0435
Cereals		Okra	0.0290
Crop Name	**Probability**	Cauliflower	0.0217
Sorghum	0.8073	Beet root	0.0072
Maize	0.1391	Raddish	0.0072

Source: calculated from secondary data; * Group of Crops

CONCLUSIONS

It was understood rain fed farms were more vulnerable to the crop raids than irrigated farms. Uncertain weather and HEC were the main reasons of uncertainty in crop production resulting in poor investment in structures to avoid crop raids. On the one hand financial instability prevented the farmers to take up steps towards mitigation of HEC by erecting physical structures and on the other hand uncertain weather and soil unsuitability reduced the range of alternative crops to be cultivated by farmers.

Crops like, turmeric, flowers, ground nut, curry leaf, fodder grass and cotton were less sensitive to crop raids but used to get physical damage due to wildlife movement in the area. Understanding elephant preferences for cultivated crops, their temporal patterns of raiding and choice of areas for raiding provided significant information for people to reduce and mitigate crop damage by elephants (Webber, Sereivathana, Maltby, and Lee, 2011). Assessment on HEC occurrence pattern reveals that most of the reported incidents occurred from late September to early February because elephants from adjacent protected areas started to move out of protected area in search of food and water during these months. Similarly, Kharif season crop would attain harvesting stage during in the same period which increased the impact of HEC in this region.

REFERENCES

1. *Chiyo, P. I., E. P. Cochrane, L. Naughton and Basuta, G. I., Temporal Patterns of Crop Raiding by Elephants: a Response to Changes in Forage Quality or Crop availability? African Journal of Ecology, 43(1), 48–55, 2005.*
2. *Kulkarni, J., P. Mehta, D. Bhoominathan, and S. Chaudhuri, A Study of Man-Elephant Conflict in Nagarhole National Park and Surrounding Areas of Kodagu District in Karnataka, India: Final Report. Pune: Envirosearch, 2007.*

3. *Menon, V. Tusker: The Story of the Asian Elephant. New Delhi: Penguin Enterprise in Association with the David Shepherd Wildlife Foundation, Wildlife Trust of India, International Fund for Animal Welfare, 2002.*
4. *O'Connell-Rodwell, C. E., T. Rodwell, M. Rice, and L. A. Hart, Living with the Modern Conservation Paradigm: can Agricultural Communities Co-exist with Elephants? A Five-Year Case Study in East Caprivi, Namibia. Biological Conservation, 93(3), 381–391, 2000.*
5. *Sukumar, R. Ecology of the Asian Elephant in Southern India. I. Movement and Habitat Utilization Patterns. Journal of Tropical Ecology, 5(01), 1, 1989.*
6. *Sukumar, R, Ecology of Asian Elephant in the Southern India. Journal of Tropical Ecology, 6, 33–53, 1990.*
7. *Sukumar, R, The living Elephants: Evolutionary Ecology, Behavior, and Conservation. New York: Oxford University Press, 2003.*
8. *Webber, C. E., T. Sereivathana, M. P. Maltby, and P. C. Lee, Elephant Crop-Raiding and Human–Elephant Conflict in Cambodia: Crop Selection and Seasonal Timings of Raids. Oryx, 45(02), 243–251, 2011.*